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The influence of institutions, governance, and public opinion on the environment: Synthesized findings from applied econometrics studies

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ABSTRACT

We synthesize the empirical contributions from the existing applied economics literature examining the influence of institutions and governance on environmental policy, environmental performance, and green investment. The literature on the influence of populism and public opinion on environmental policy adoption is also reviewed in line with the special issue. First, the paper describes how the relationship between institutions, environmental performance and environmental policy have been conceptualized and operationalized in the literature and summarizes the main findings. The second part of the paper outlines avenues for future research with specific attention to the energy transition and climate change literature. With respect to the positivist worldview adopted by this paper, we highlight various opportunities for empirical work that have recently emerged with the growing availability of data in the field of green investments, climate, and energy policy. Expanding the current empirical literature towards these research topics is of both scientific and policy relevance and can provide important insights on the broader field of sustainability transition and sustainable development. Regarding the alternative, non-positivist worldviews, future research could explore ways to connect the richer approaches such as complex adaptive systems and socio-technical transition studies with applied econometric methods, as well as future-oriented studies.

1. Introduction

The ability of environmental interventions to achieve the objectives they are designed for depends on the political process leading to policy adoption as well as on the nature of the underlying institutions, dominant ideas, cultural discourses, the industrial structure, and the distribution of resources and power [1,2–4]. Designing targeted economic, social, and environmental policies will play a crucial role in steering and fostering this transition towards sustainability. Yet, since environmental interventions are essentially economic policies ultimately implemented by bureaucrats in a broader institutional setting [5], the quality and efficiency of institutions crucially affects the effective implementation and monitoring of policies [6].

In this review, we synthesized findings from the applied econometrics literature to examine the influence of institutions and governance on environmental policy, environmental performance, innovation, and green investments at the national level. We describe and summarize the main findings on how the relationship between institutions and various indicators of environmental performance and environmental policy have been conceptualized and operationalized. Along with reviewing impacts of institutions and governance on physical indicators such as indicators of environmental performance, we also reviewed the literature on the relationship between institutions and green investments and innovation, considered fundamental drivers of sustainability transition. Finally, we reviewed the empirical literature on the impact of public opinion and populism on environmental policy adoption to reflect the growing influence of right-leaning populism.

Review papers always face a trade-off between inclusiveness and degree of detail, we acknowledge the limited scope of this paper, being centred around quantitative studies that use a specific method, namely econometric analysis. The motivation for this choice is the objective behind this paper, namely to inform the macroeconomic models used for policy analysis. Integrated Assessment Models (IAMs) have become a key analytical tool to exploring plausible pathways towards sustainable futures. They use mathematical relationships to provide a simplified representation of the climate, economy, and energy systems, as well as their interactions, and focus on the consequences of exogenously specified policies. Given the growing attention towards the implementation of environmental and climate policies, these tools need to incorporate the interplay between economic, political, institutional and

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Table 1
Unpacking the explanatory variables used in the literature.

Independent variable	Response variable		Number of studies
Institutions and governance	Environmental performance	Emissions, deforestation, land degradation, protected areas	43 of 60
		Green investments	5 of 43
	Environmental policy adoption	Policy stringency	9 of 60
		Participation in IEAs/MEAs	8 of 60
Total number of reviewed papers			(43 + 9+8) = 60

as well as socio-cultural changes. One approach to address this need is to parametrize the models with econometric estimations – focus of this review paper.

The goal of our paper has also implicitly determined the selection of the papers we reviewed. We have analysed econometric papers from the applied economics literature focusing on institutions and environment – either in terms of environmental performance, environmental policies, green innovation, green investments and the impact of public opinion on policy adoptions. Empirical studies from the applied economics literature quantitatively examine the relationship between institutions, or more broadly political economy factors and various indicators of policy adoption, policy effectiveness, and environmental outcomes. They rely mostly on observed cross-sectional or longitudinal data, and in some cases on the use of natural experiments. Reduced-form equations building on hypotheses grounded in theoretical frameworks are generally used to formalize simple models testing a causal relationship between quantifiable variables.

We review 60 papers dealing with the impact of institutions and governance on a range of environmental performance indicators and of policy adoption. The main indicators of institutional quality, environmental performance, and policy used in the literature are classified. Based on the key findings, we summarize the main hypotheses. We conclude by outlining avenues for future research in the specific context of climate change and energy, and describe opportunities for future work that have emerged with the recent advances in data collection and empirical methods. We find that 43 out of the 60[1] reviewed papers have evaluated the impact of institutions and governance on environmental performance indicators such as emissions (methane, carbon dioxide, sulfur dioxide, chlorofluorocarbon, and nitrogen dioxide), pollutants (water pollutants, air particles, carbon monoxide, and lead), deforestation, land degradation, and protected areas. Only 5 out of 43 studies (Table 1) have looked at the impact of institutions and governance on green investments. Of the reviewed papers, 17 have investigated the impact of institutions and governance on policy adoption, 9 of which use policy stringency as the dependent variable.

Greater democracy, more civil liberties, and experience with democratic systems of government generally lead to greater environmental protection policies, including greater participation in international environmental agreements and better environmental performance outcomes. Public opinion matters in democracies, but it can be a 'double-edged sword' as the rise of right-leaning populism threatens to bring about worse environmental policies and outcomes, or reverse previous progress with environmental policies and energy transition. This seems particularly relevant for the US, where the right denies the existence and policy importance of climate change. Increased levels of corruption tend to lead to environmental degradation, fewer environmentally friendly laws being passed or adopted, and acts as a barrier to green investment and innovation.

[1] We must note that, these sixty papers plus six papers on populism and public opinion were reviewed critically, i.e. we provide detailed information on the response variable (environmental performance and environmental policy indicator) and the major independent variables (institutional/governance/public opinion indicators) along with the methodology and results in Tables A2 and A3 in Appendix A.

Our review of the literature on public opinion and environmentally friendly policy outcomes suggests that, although public opinion has a substantial positive impact on passing and adopting environmental-friendly laws and regulations. Unfavorable public support can also act as a major barrier to transitioning to a low-carbon economy. This could be cause for concern, as public support for climate change policies may decline with the rise of right-leaning populism. In the case of energy transition, countries where energy regulators are under parliamentary authority and commitment from the government are more likely to achieve sustainable energy transition.

We also highlight that, despite the empirical literature on this topic being rather broad, the focus has mostly been on physical performance indicators (e.g. GHG emissions or pollutants) or on policy adoption choices that are dated (e.g. signing and ratification of the Kyoto Protocol). In this view, we discuss how expanding the field of research to analyze the impact of institutions on green investments or policy stringency in a more systematic manner is ripe for investigation and review the few papers that have started investigating this topic.

We do not conduct a systematic review but have focused on providing an in-depth review of the empirical literature on the influence of institutions, governance, democracy, corruption, and public opinion on environmental performance and environmental policy adoption. The papers reviewed were chosen based on this particular outline and most of them were chosen from Google Scholar using variants of "impact of institutions/governance/democracy/corruption/public opinion on environmental performance/environmental policy". However, some of the papers were chosen from references of other papers.

The remainder of paper is structured as follows. Section 2 provides definitions and concepts of institutions and governance while Section 3 presents the review of the existing literature organized as follows; four sub-sections study the impacts of institutions and governance on environmental performance (3.1), environmental policy (3.2), investments (3.3), and innovation (3.4). Sub-section (3.5) reviews the literature on populism and public opinion and environmental policy and (3.6) provides an overview of political systems and energy transition. Section 4 discusses the research gaps and priorities with a focus on the political economy of green transition and Section 5 concludes. Detailed information on the dependent variables (indicator for environmental performance/policy/investment), independent variables (indicator for institutions/governance/corruption/public opinion), methodology used, and main results for each of the paper reviewed are provided in Tables A2–A4 in Appendix A.

2. Definitions, concepts, and philosophical worldview

The concept of institutions has been used in different contexts, often with dissimilar meanings, making it difficult to provide an unequivocal definition. For example, sociology refers to institutions as a broader set of; (a) regulatory, (b) cultural-cognitive, and (c) normative rules [7]. From this perspective, institutional change refers not only to the direct effect of policies and formal prescriptions (institutions type a) but also to changes in how we see and understand the world, how our mindset influences our decisions (institutions type b), changes in our normative aspirations, and what we consider 'good' (institutions type c).

In this review, we adopt an economic perspective and focus on formal institutions [8] as the rules of how markets operate. They can be further grouped into legal (e.g. judiciary and legislature), political (e.g. form of government, democracy or autocracy), and economic (e.g. government tax-collection agencies) institutions. Legal institutions take the form of legislature, public or state-devised legal institutions, and private legal institutions. In economics, political institutions are defined as those shaping policy decisions by constraining the set of feasible choices of the decision-makers. They determine the process of creating and enforcing laws and of governmental policymaking. Economic institutions have overlapping characteristics with political institutions and their functions are often difficult to disentangle [8]. In the political economy literature, political institutions often determine the scope of economic institutions. Economic institutions must perform functions such as establishing and protecting property rights, facilitating transactions, permitting economic co-operation, and organization [9]. A related and to some extent overlapping concept of governance can be broadly defined as the traditions and institutions that determine how authority is exercised in a country [10] while the World Bank defines governance as the power exercised through a country's institutions. In other words, governance is a political concept that includes measures involving setting the rules for the exercise of power and settling of conflicts over these rules. Normative and cognitive institutions as defined by Scott [7] are difficult to measure[2] and most of the environmental economics literature has focused on regulatory institutions or formal institutions [11,12]. We have focused on economic institutions as the emphasis of our review is on the applied econometrics literature, which require measurable indicators for analysis. A summary of the explanatory variables most commonly used in the papers we have reviewed is presented in Table 1 below while Table A1 in Appendix A summarizes the institutional indicators classified into economic, legal, and political institutions that have been most frequently used in the literature.

Notwithstanding the focus of this review, we acknowledge the existence of several other conceptual frameworks. Just to mention a few examples, socio-technical transition studies use a broad notion of governance and institutions [13] as describing the key processes of steering and decision-making. This discipline emphasizes the role of different actors beyond the national and state governments, including actors, organizations, structures, networks, and relationships that contribute to decision-making and influencing societal processes. It highlights the difference between institutions as referring to the actions of the state or the government and governance (e.g. the role of non-state actors, such as businesses and nongovernmental organizations in the process of societal steering). Another strand of literature, based on studies of complex adaptive systems describe the relationship between governance, institutions and the environment as complex interconnected mechanisms evolving together [14–16]. This literature also suggests that greater flexibility and multi-agency governance are required for transition of energy systems and efficient implementation of environmental policies [16–18]. On this note, Andrews-Speed [19] uses institutional theory to show that the interaction between political and economic institutions influence the pace and type of low-carbon transition.

2.1. Philosophical worldviews

The focus of the paper is on the econometrics literature on the impact of institutions and governance, which are based on positivists worldview. The positivist, also known as empirical science and post-positivism research worldview, is characterized by empirical observation and measurement and theory verification. This worldview holds a deterministic philosophy of cause and effect and states that knowledge is shaped by data and evidence [20]. This is one possible worldview among the several other alternatives that exist, such as constructivism, advocacy/participatory, and pragmatism.

Constructivism or social construction theory posits that actors' decision-making and behavior is influenced by ideas. In the case of institutions, social constructivism holds that institutions are not only constraints but also influence the individual [21] and that institutions are social constructs [22,23]. In the literature on institutions and the environment, a number of papers have used the constructivism worldview to study international environmental policies. Miles et al. [24] and Andresen et al. [25] find the role of social-learning in formulation of international environmental policies. Haas [26] claims that while non-binding environmental treaties allow states to act more co-operative in adopting these treaties, they result in lack of implementation.

Advocacy/participatory worldview is usually associated with qualitative rather than quantitative research (the focus of this paper) and tends to incorporate politics and a political agenda within research inquiry.

The Pragmatic worldview arises out of actions, situations, and consequences instead of antecedent conditions and is concerned with applications and solutions to problems [27]. In the context of institutions and environment, the environmental pragmatism literature argues that environmental protection through environmental policymaking requires strong institutions and participatory democracy [28,29].

Along with limitations of econometric studies such as spurious relationship between variables, econometric studies are unable to embody collaborative (advocacy/participatory worldview) or theory generation (pragmatism worldview) aspects of research. Additionally, the constructivism, advocacy/participatory, and pragmatic worldviews provide critical contribution to the literature on institutions and environment. Bearing in mind the dominant worldview for this paper, the positivist view, Section 3 turns to the review of papers from the applied econometrics literature.

3. Institutions and the environment

The theoretical argument for government activity in the context of the environment is provided by the public-good nature of environmental protection. Private agents systematically fail to consider the full costs of pollution due to the associated externalities, creating the scope for government intervention [30]. Relevant questions include the degree of government intervention and the ways different forms of government (political institutions) and electoral arrangements affect environmental regulations and ultimately environmental performance. The following four sub-sections review the literature examining the relationship between institutions and governance, and (3.1) environmental performance, (3.2) policy adoption, (3.3) investments, (3.4) innovation. While sub-sections (3.5) looks at the impact of public opinion on environmental policy.

3.1. Institutions and environmental performance

A few papers have investigated the relationship between various indicators of institutional quality and environmental performance. Table A2 in Appendix A summarizes the most common types of environmental performance indicators[3] used in the literature as dependent variables. They refer either to emissions such as carbon monoxide (CO), chlorofluorocarbon (CFC), methane (CH_4), carbon dioxide (CO_2), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead content of gasoline, or to activities related to environmental degradation such as

[2] Though Fredriksson and Wollscheid [191] show that countries with French civil law background are likely to have stricter climate change policies compared to countries with British civil law.

[3] The terms environmental performance and environmental quality are used interchangeably in the literature.

deforestation or status of protective areas. The most commonly used institutional indicators are democracy and polity scores from Polity IV [183,184] and Freedom House, voice and accountability from the World Governance Indicators (WGI), and corruption perception from Transparency International (TI) [185]. Some papers have also used rule of law from WGI and other indicators related to the strength of civil society (Appendix A: Table A1). Other indicators such as lobbying, veto power, and composition of parliamentary systems have also been used in the literature.

The main hypothesis being tested using the indicators discussed above is whether democracy, governance, democracy, and corruption allow the electorate to exert policy pressure on the government [31,32] and facilitate or constraint the ability of governments to implement such measures. Another hypothesis is whether (more) democratic countries and open societies are more likely to provide public goods in the form of environmental protection [2]. In this context, Dasgupta and Maler [33] suggest that civil[4] and political[5] rights are rather influential in ensuring environmental quality, especially in comparison to authoritarian regimes.

3.1.1. Democracy and environmental performance

The most common indicators of institutions and governance used in this subset of literature are the polity scores and democracy variable from the Polity (III and IV) database, democracy indicator from the Freedom House Index, and the rule of law indicator from WGI. Olson [34], find that democracies fail to protect the environment, the authors state that as democracies become more mature, the growing number of interest groups is less likely to act and cooperate in common interest since the gains from the collective good environmental protection decreases. Congleton [35] argues that democracies often have shorter policy horizon due to political uncertainty, hence cannot undertake the long-run reforms required for climate change. Deacon [36] finds that democracies are more likely to ensure positive environmental performance, arguing that non-democratic regimes or autocracies are less likely to provide such public goods since resources are concentrated in the hands of a small group and thus, the burden of public good costs fall mostly on those controlling these resources. This finding is supported by several papers including, Deacon [37], Bueno de Mesquita et al. [38]; and Bernauer and Koubi [39]. Fredriksson et al. [40] also conclude that both democratic competition and democratic participation reduces lead content in gasoline while Li and Reuveny [41] find that higher levels of democracy (Polity IV) reduces emissions of CO_2, NO_x and organic pollution in water, lowers deforestation rates, and results in less land degradation.

Torras and Boyce [42] report that political and civil rights as measurement of democracy in low-income countries have a positive effect in reducing smoke, heavy particles, and dissolved oxygen. Esty and Porter [43] also conclude that civil and political liberties help reduce urban particulates and SO_2. Similarly, Binder and Neumayer [44] find evidence of greater democracy resulting in lower pollutant levels with respect to SO_2, smoke, and heavy particulates, while Neumayer [45], using data from 150 countries concludes that higher democratic quality may result in a greater share of land area being protected. Barret and Graddy [31] find that greater political freedom leads to better air and water quality, while comparing democracies and autocracies, while Ward [46] concludes that stable autocracies perform worse on strong sustainability (carbon footprint) compared to stable democracies.

However, a few papers have found that democracies can result in deteriorating environmental performance or have no impact. Midlarsky [32] finds that democracies result in worsening environmental performance in terms of CO_2, deforestation, and soil erosion. But Shandra [47] find no effect of democracy in reducing deforestation while Ehrhardt-Martinez et al. [48] report that weak democracies are unable to reduce deforestation. Carlsson and Lundstrom [49] similarly conclude that political freedom has no effect on reducing levels of emission of CO_2, while Jorgenson [50] find the same for CH_4. Deacon [36] shows a that democracy (Polity III) Jaggers and Gurr [180] results in worsening lead levels and Roberts and Parks [51] find that democracy had no impact on national pollution levels of CO_2. Scruggs and Rivera [52], using cross-section OLS find no evidence that countries with long-established democracies have better environmental performance. Buitzenzorgy and Mol [53] find an EKC relationship between democracy and environmental performance (using deforestation as proxy) and that deforestation rates are lower under autocracy and mature democracies. However, Joshi and Beck [54] find no evidence of CO_2 EKC relationship for OECD countries. Furthermore, they also conclude that politically free non-OECD countries have higher CO_2 emissions.

Statistical and socio-political arguments have been used to explain the differences in results among these papers. Statistical arguments include different sample sizes and different indicators used across the studies. Regarding the issue of sample size, the environmental data gap between developed and developing countries, resulting in selection bias may have affected the estimations, while different methodologies have also played their part. To include as many countries as possible, authors have often resorted to using regressions using cross-sectional data, which only provide a snapshot of situations in a specific point in time and are more likely to be affected by endogeneity and omitted variable bias. In general, the use of simple OLS type regressions might lead to results that are not as robust.

3.1.2. Governance and environmental performance

Unlike the indicators of political institutions such as democracy, rule of law from WGI has a rather clear-cut prediction implication. Stronger governance usually leads to better environmental policy adoption measures and outcomes. Castiglione et al. [55] show that stronger rule of law results in a reduction of pollution while Castiglione et al. [56] demonstrated that when rule of law is strong, the turning point of the Environmental Kuznet Curve (EKC) occurs at a lower level of income per capita, thus, decreasing emissions. Culas [57] concludes that enforceability of contracts by governments reduces rate of deforestation, while Bhattarai and Hammig [58] find that greater political rights and civil liberty results in a reduction in annual deforestation rates.

However, a few papers have also found no statistically significant effect or even a adverse relationship between good governance and environmental quality, e.g. Murdoch et al. [59] find that civil liberties and political freedom reduces sulfur emissions but not NO_x in Europe. These results seem to depend on the indicator used for environmental performance.

In the specific issue of energy transition, the literature states that political and regulatory stability are often the key [60]. The role of institutional change and adaptation is also critical for reducing uncertainty and managing the risks related to low-carbon transition [61,62]. Against this backdrop, however, Rogge and Johnstone [63] conclude that electoral and partisan politics play a more significant role than institutional strength and framework. While Bahn-Walkowiak and Wilts [64], building on Rogge and Reichard [65], conclude that stronger emphasis on the institutional set-up is necessary to ensure an efficient policy mix for energy transition, especially given the significant differences between countries.

3.1.3. Corruption and environmental performance

Welsch [66] studies the impact of corruption on pollution and finds

[4] Civil liberties, including freedoms of expression, assembly, association, education, and religion. They have an established and generally fair legal system that ensures the rule of law (including an independent judiciary), allows free economic activity, and promotes equality.

[5] Range of political rights, including free and fair elections. Candidates who are elected actually rule, political parties are competitive, the opposition plays an important role and enjoys real power, and the interests of minority groups are well represented in politics and government.

Table 2
Institutions, Governance, and Environmental Performances – Main findings by performance indicator and by institutional variables. See Table A2 for more details on individual studies.

	Positive relationship - Increase in institutional quality improves environmental performance	Negative relationship – Increase in institutional quality reduces environmental performance	Ambiguous (positive or negative depending on the specification)	Results are not statistically significant
		Environmental performance indicator		
Protected area	0	0	0	1
Sustainability	1	0	0	0
Vulnerability	1	0	0	0
Land degradation	1	1	0	0
Protected land	3	0	0	0
Lead	3	0	0	0
Air pollution	5	0	0	0
Deforestation	7	0	1	2
Other pollution	7	0	0	1
CO_2	4	2	1	4
Emissions, other	12	2	0	5
		Institutional variable		
Governance	4	1	0	0
Corruption	10	0	0	0
Civil, Political Freedom	17	2	0	2
Democracy	16	3	2	11

that corruption has both direct and indirect impact on pollution, where direct impact refers to the effect of corruption on pollution via less stringent environmental laws and indirect effect refers to the effect of corruption on per capita income and the resultant impact on pollution. The author concludes that corruption increases the levels of emission and pollution regarding NO_2, CO_2, total suspended particulate concentration, phosphorus concentration, and suspended solids. Similarly, Cole [67] finds that corruption increases per capita emissions of sulfur dioxide and carbon dioxide and that indirect impact were increasing in higher income countries.

A number of other papers have found evidence of corruption adversely affecting biodiversity and sustainability [68,3,69–71].[6] However, a common criticism of these papers is the use of aggregate measure of sustainability such as the Ecological Sustainability Index.

As summarized in Table A2, papers considering multiple performance indicators, such as Torras and Boyce [42], Welsch [66], Li and Reuveny [41], Scruggs and Rivera [52], generally find robust results across indicators, Murdoch et al. [59] and Midlarsky [32] being exceptions.

Table 2 below summarizes the main findings from this branch of literature (provided in detail in Appendix A: Table A2) by performance indicators and institutional variables. The studies that find a prevailing positive effect are those studying impacts on air pollution and other indicators of emissions including SO_2, NO_2, and CH_4, while the evidence on CO_2 seems to be mixed. Our review (summarized in Table 2) shows that whereas democracy tends to have ambiguous effects, increased civil and political freedom and better governance have had positive impacts.

3.2. Institutions and environmental policy

In this section, we review the literature on the impact of different institutional settings on governments' decisions to adopt environmental policies. We focus on the literature investigating the impact of institutions and governance on environmental policy adoption and implementation (see Table A3 in Appendix A). This body of the literature is less extensive than the one on institutions and environmental performance. The most commonly used indicators of political institutions are democracy (Polity IV and Freedom House), corruption (TI), composition of parliaments and government, economic institutions, and various indicators from WGI.

3.2.1. Democracy and environmental policy

Our review suggests that democratic countries are more likely to pass legislation and join global environmental treaties such as the Montreal Protocol, the UNFCCC, the Kyoto Protocol, and the Convention on Biological Diversity [45,72–74,182].

Neumayer [75] concludes that democracies exhibit stronger international environmental commitment than non-democracies, and that political freedom seems to increase the chances of adopting environmental policies but economic freedom has no effect. Damania et al. [76] show that civil freedom has an insignificant effect on compliance with international environmental agreements and Murdoch et al. [77] use a two-stage game and a spatial Probit model to find that democracy can be a barrier to collective action on international environmental treaties. Fredriksson and Ujhely [78] conclude that greater number of government units reduces the positive impact of environmental agreements and that greater environmental lobby group strength raises the probability of ratification.

Fredriksson et al. [40] find that greater political competition and the number of environmental groups raises the stringency of environmental policies, but democratic participation affects environmental policy stringency only in countries with sufficiently high degree of political competition. These papers use environmental lobbying, democratic participation, and political competition as the major independent variables. Bättig and Bernauer [79] use a panel regression and show that the effect of democracy on levels of political commitment to climate change mitigation is positive but the effect on policy outcomes, measured in terms of emission levels and trends, is ambiguous (see previous section). Comparing different political regimes, Congleton [35] concludes that authoritarian regimes enact less stringent environmental standards than democratic regimes while liberal democracies are more willing to regulate environmental pollution and that international agreements on environmental matters attract more signatories as the number of democratic regimes increases. Fredriksson and Neumayer [80] use cross-sectional data from 87 countries to argue that historical experience with democracy rather than current level of democracy is more important for passing stringent environmental policies.

[6] For a detailed review on natural resources and corruption, see Kolstad and Søreide [186].

3.2.2. Governance and environmental policy

Fredriksson et al. [73] conclude that increased environmental lobby group activity raises the probability of Kyoto Protocol ratification and that this effect increases with levels of corruption. Fankhauser et al. [81], using negative binomial and logit models find no significant impact of political orientation on the number of climate laws passed. The authors also find that propensity to legislate is heavily influenced by the passage of similar laws in other countries, indicating towards the role of peer pressure and/or learning effects.

Very few papers have attempted to investigate the impact of lobbying and veto power on environmental policy. This remains one of the critical gaps in the literature. Roberts et al. [82] find that freedom of expression and citizens' ability to participate in selecting their government and pressure from NGOs are the most important factors in determining a country's propensity to sign environmental treaties, while Fredriksson et al. [83], using stratified hazard models find similar results. Fredriksson and Millimet [84], using propensity score matching find that countries with propositional systems tend to have stricter environmental policies and Fredriksson et al. [40] show that environmental lobby groups tend to increase the stringency of environmental policy. Moreover, the authors conclude that political competition tends to raise policy stringency, particularly where citizens' participation in the democratic process is widespread. List and Sturm [85] use data on the behavior of U.S. governors between 1970 and 2000 and find that binding term-limits play a significant role in environmental policy. The authors conclude that in states with substantial green voters, governors advance less environmentally friendly policies if they cannot be reelected (binding term limit) however, the opposite in observed for states with relatively small number environmental voters. This suggests that governors reverse policies to attract voters once faced with binding term limits.

3.2.3. Corruption and environmental policy

Using the Corruption Perception Index (CPI) to investigate the impact of corruption on environmental policy, Fredriksson et al. [83] state that corruption increases energy waste by reducing the stringency of energy regulations. They also find that lobbying efforts are less successful in the larger sectors but lobbying by environmental groups has been suggested as an influencing factor for the ratification of the Kyoto Protocol by Murdoch et al. [77]. This notion has been empirically tested by other papers, which suggest that the strength of the environmental lobby and the level of corruption are drivers of ratification of the Kyoto [73,78].[7]

Environmental regulations are imposed and monitored by bureaucrats who may be corrupted and acting on their personal interest [86]. Fredriksson et al. [83] investigate the impact of corruption[8] on energy policy and find that higher degree of corruption among bureaucrats result in less stringent policies, increased coordination costs of the special interest groups means more stringent policies and capital owners and workers have opposite lobbying interests on energy policy. Fredriksson and Svensson [87] and Damania et al. [76] show that higher corruption reduces the stringency of environmental regulations, which is reflected in lower improvements in energy intensity, but this effect declines as political stability increases. Fredriksson and Svensson [87] also provide evidence of adverse effects of corruption on the effectiveness of environmental regulations using cross-country data. Furthermore, Pellegrini and Gerlagh [88] find that an increase in corruption perception results in a reduction in the environmental protection index, while Ivanova [89] concludes that though countries with more effective environmental regulations may have higher reported levels of emissions, their actual pollution levels are likely to be lower than nations with less effective regulation. Fredriksson and Neumayer [90], using the concept of corruption-control capital stock, find that accumulated history of being corruption free results in greater cooperation in environmentally sustainable development and adoption of environmentally friendly policies. As mentioned in Section 3.2.2, only a few papers have attempted to investigate the impact of lobbying and veto power on environmental policy.

Table 3 below summarizes the main findings from this branch of literature (also provided in detail in Table A3) from papers investigating the relationship between institutions and environmental policy adoption or implementation. The agreement among the reviewed paper is almost unequivocal, with only 2 out of 17 studies finding an adverse or an insignificant relationship. Most studies have used cross-sectional data but some of the recent papers have used panel regression analysis.

3.3. Institutions and investments

The papers reviewed in Sections 3.1 and 3.2 have mostly used physical indicators such as GHG emissions or pollution intensity as indicators of environmental performance. Since investments and innovation, even though not necessarily directly related to energy and the environment are also important topics in the literature on sustainability transition. In this section, we review the papers that investigate the relationship between institutions, investments and innovation within and outside the energy and environment domain.

There is a rather broad literature on the influence of institutions and governance on investments, especially on Foreign Direct Investments (FDI). Brunetti et al. [91] conclude that political instability increases uncertainty, which makes a country less attractive to foreign investors while Busse and Hefeker [92] find that increased government stability, democratic rights, and law and order have a significant positive influence on FDI inflows. Jensen [93–95] and Feng [96] also find that democracy reduces political risks in countries and encourages FDI inflows. Using dynamic OLS regressions, Coe et al. [97] finds that countries with higher ranking in the ease of business index, better patent protection, and German and English law origin receive greater R&D benefits and international R&D spillovers.

The dominant view in the literature is that good governance and low levels of corruption promote investments and attract FDI and that a malfunctioning government increases costs and investment risks. These findings have been empirically supported by several studies [98–101]. However, a few papers have provided contrary evidence that corruption often attracts FDI. According to Bellos and Subasat [102], this is the result of the prevailing effect of "grease the wheels" mechanism, which argues that corruption can compensate for poor governance and speed up inefficient bureaucratic processes to attract FDI [103–105,181].

In the context of green investments, Gennaioli and Tavoni [106] study the link between public support schemes for renewable energy and corruption and find that the number of green energy projects increased in Italian provinces with corruption. Specifically, an increase in criminal activity, most likely due to inefficient institutions, results in an increase in the number of green projects in Italian regions. Bellos and Subasat [102] also use the term "sand the wheels" for the cases where corruption acts as a deterrent to FDI. Fredriksson and Wollscheid [107] greater corruptibility increases the level of investment in pollution control technology conditional on the degree of political instability. A number of papers find in support of this relationship [108–110].

However, the literature on the impact of these factors as determinants of environmental investment and investments on clean energy is rather limited. Iyer et al. [111], in an IAM framework, find that investment risks are higher in regions with inferior institutions. The authors suggest that institutional reforms leading to lower investment risks could be an important element of cost-effective climate mitigation strategies. Verdolini and Vona [112] conclude that reduced entry barriers, measured using OECD's indicators of market regulation (rent on market entry, privatization, and unbundling), results in an increase in investment on renewable energy. However, the authors find no evidence of institutional quality influencing investments in renewable energy. Masini and Menichetti [113] examine the impacts of non-financial factors in Renewable Energy (RE)

[7] Corruption Perception Index, Transparency International and World Bank WGI.
[8] Corruption Perception Index, Transparency International.

Table 3
Institutions, Governance, and Environmental Policy – Main findings by institutional variable and environmental policy indicator. See Table A3 for more details on individual studies.

	Positive relationship - Increase in institutional quality increases environmental policy adoption	Negative relationship - Increase in institutional quality reduces environmental policy adoption	Ambiguous (positive/negative depending on the specification)	Results not statistically significant
		Institutional variable		
Corruption	5	0	0	0
Democracy	6	1	0	0
Governance	3	0	0	0
Governance and Democracy	1	0	0	1
		Environmental policy indicator		
IEA/MEA	9	1	0	0
Policy stringency	6	0	0	1

investments, including behavioral (priori belief, propensity for radical technologies, investors' knowledge of the RE operational context) and institutional factors (institutional pressure from peers, consultants, and published sources of information). The authors find that the behavioral context plays an important role at shaping the incentive to invest in RE and the beliefs about technical feasibility and proven performance seem to be particularly important.

While conventional research considers green and clean investment as an effective method to tackle the environmental crisis, the degrowth literature opines that increased investment is more likely to lead environmental degradation [114]. This is related to Jevons Paradox [115], which suggests that while the efficient use of resources enables growth, it also results in environmental degradation (inefficient use of natural resources from a sustainable point-of-view). Essentially, increasingly efficient technologies enable growth and leads to greater overall resource use and pollution.

3.4. Institutions and innovation

Suurs [116] outlines several elements and factors that influence the productivity of innovation systems in the context of wind, solar, and biomass energy, as well as energy-saving technologies. Those factors include innovative entrepreneurs, knowledge development and diffusion, market formation and growth while emphasizing on the necessity for efficient institutions and rule of law at the core of influencing innovation systems. The author states that institutions must provide appropriate policies and strategies along with long-term commitment to foster innovation systems.

The literature on the impact of institutions and governance on innovation spans several decades but includes very few empirical studies. In one of the early papers, Freeman [117] concludes that quality of institutions is critical for the creation of new technologies while Lundvall [118] states that the economic structure and the institutional set-up have a strong effect on innovation.

Weak institutions increase uncertainty and are likely to have an adverse effect on innovation while efficient institutions may expedite the process of registering new patents,[9] diffusion of knowledge, enforcement of property rights, and reduce the uncertainty of new projects [119–121]. While Sala-i-Martin [122] states that it is difficult to spur innovation without efficient institutions and Levchenko [123], using a mixed-model approach shows that countries with better institutions are more likely to specialize in the production of highly technical goods.

In a theoretical framework, Tebaldi and Elmslie [124] shows that the impact of institutions on innovation spillovers to income is likely to improve as the quality of institutions improve. Recent papers also suggest that better institutions are likely to aid innovation [125,126]. Tebaldi and Elmslie [126] uses an instrumental variable approach to study the impact of control of corruption on US patent counts between 1970 and 2003 and find that improving control of corruption increases the probability of patents filing and registration. Silve and Plekhanov [127] use various measures of industry exports value, industry output, and industry growth rates as indicators of corruption and conclude that good-quality economic institutions (measured by WGI) boosts long-term economic growth through innovation. Dasgupta et al. [6], using data for 20 OECD countries during 1995 and 2010 investigate the impact of environmental policy stringency (market and non-market instruments), governance, political orientation of governments, and lobbying power of energy intensive industries on energy R&D and patents. The authors find that market-based incentives and to some extent non-market-based incentives results in dynamic efficiency gains, while countries with better governance are characterized by higher levels of energy-related R&D. They also find that left-wing governments are more likely to devote R&D resources to the energy sector, and larger energy intensive sectors can induce market-size effects and have more lobbying power for more resources to be allocated to energy R&D. This is in contrary to findings from one of earliest papers in this discipline by Jahn [1] who concluded that strong socialist-democratic governments tend to have an adverse impact on environmental performance,

There are a few papers on the impact of corruption on innovation[10] that find that corruption is harmful for innovation efforts [128,129]. Murphy et al. [130] argues that corruption from government officials particularly affects innovators because these firms have a high demand for government permits and licenses while Ayyagari et al. [131] find that innovative firms are more likely to pay bribes compared to non-innovators. On the other hand, it has also been argued that corruption can be somewhat beneficial by creating opportunities for illicit private gains for firms, such as paying "cash for contracts" [132]. These are in line with the "grease the wheel" and "sand the wheel" concepts by Subasat and Bellos [105].

3.5. Public opinion and environmental policy

While the literature on the influence of public opinion and social movement on government policy is expansive and goes back to the 1970s [133,134], the empirical literature on the impact of public opinion on environmental policy is mostly focused on the adoption and passing of environmental protection laws and regulations [135–137]. Furthermore, a significant part of this literature is focused on the US [135,136,138]. The rise of populism in Europe and in other parts of the world has increased the attention on the "demand-side" of environmental policy. Theoretically, increase in pro-environmentalism public sentiment shifts is a signal for policymakers for legislating pro-

[9] In the empirical literature investigating the impact of institutions and governance on innovation, patents are generally used as a measure of innovation.

[10] However, in our opinion they do not warrant a new subsection.

environmental policies to reflect public demand for environmentally friendly policies [137].

Agnone [138], using the yearly count of environmental movement protest events and environmental advocacy (measured as the annual count of non-protest related environmental movement events) as reported in the *New York Times Annual Index* for the years 1960–1998, investigate the impact on passage of environmental friendly laws. The author uses WCALC algorithm to tabulate an environmental attitudes index. The WCALC program combines the results of various survey questions and extracts common components, assuming questions relate to an identifiable latent dimension (support for environmental protection in this case). The paper concludes that an increase in public support along with protest/advocacy for environmental protection has a positive impact on the passage of environmental laws. Relatedly, Valdez et al. [139] find that protest attitude is influenced by income, protest experience, and political efficacy with no impact of trust in institutions.

Building on Agnone [138], Johnstone et al. [140] find that public opinion and protest movements on environmental issues have a greater influence on Congressional-agenda setting than on actual passage of environmental laws between 1961 and 1990. However, environmental movement does influence law passage when coupled with effective institutional influence and protest activity. The authors use *The Dynamics of Social Protest Project* to collect data on environmental movement collective action events as a proxy for activities and protests for environmental protection laws.

Anderson [136] uses environmental group membership (Sierra Club, the Nature Conservancy, the National Wildlife Federation, and the National Resources Defense Council) as a proportion of district population to study the environment related voting behavior of members of the US Congress. The dependent variable used is the League of Conservation Voters' (LCV) Environmental Score for each member of the House of Representatives. The paper concludes that Members of Congress are more likely to vote more pro-environmental when there are more members of environmental groups in a particular district.

Vandeweerdt et al. [141] used the votes cast for the acceptance or rejection of four legislative proposals in US Congress that included greenhouse gas emission limit to investigate the impact of climate change public opinion on climate laws. Public opinion was extracted from five Cooperative Congressional Election Study (CCES) surveys, using responses to the statement 'Global climate change has been established as serious problem, and immediate action is necessary.' The authors find strong relationship between public opinion and congressional votes on climate laws, even after controlling for confounding variables such as presence of interest groups and campaign contributions.

Shum [142] used the World Values Survey [201,202] from 1995 to 2005 to study the influence of environmental concerns related public opinion on the Environmental Performance Index (EPI), which provides environmental performance and policy outcomes on a country-by-country basis. The author concludes that public opinion has significant effects on environmental policy outcomes.

Anderson et al. [137] use questions on reducing pollution and protecting nature from the EU Eurobarometer survey to measure public opinion on climate change. The response variable is a count of the number of renewable energy policies introduced by each European country in each year between 1974 and 2015. The authors conclude that shifts in public opinion in the direction of pro-environmentalism significantly increase the adoption of renewable energy policies in Europe.

Further to the issues pointed out above, since right-leaning populism is more likely to be hostile to environmentally friendly policies, disinformation regarding the importance of climate change may result in the public 'losing interest' in environmental issues [143–145]. This in turn may result in falling demand for environmentally friendly policies [146]. Agnone [138] also find that the impact of public opinion on legislative action is greater depending on the level of protest, this could result in differentiated legislative actions even within countries (US) or regions (EU).

Along with the rise of right-leaning populism, polarization among the public has also increased in the recent years [147–149]. This has led to an increase in climate change scepticism and denial [150–152]. At the same time, sceptic media coverage regarding climate change and right-leaning think-tanks challenging environmental policies have also increased [153,154,151]. While these issues have increased since the election of Donald Trump in US, parts of Europe have also experienced increases in climate scepticism and climate denial [155,156]. Kammermann and Dermont [157] find that increased levels of climate scepticism among both political actors and the general public results in declining support of clean energy policy and transition in Switzerland.

Two of the major constraints to the research on the impact of public opinion on environmental policy adoption/implementation are; (1) lack of concern regarding the risks posed by climate change among the general public [141] and (2) data availability and measurement problems of both environmental policy adoption/implementation and public opinion indicators.

The review of the literature on the impact of public opinion on environmental policy outcomes suggests that the "demand side" of environmental policy is a "double-edged sword". The literature provides ample evidence that public opinion has a substantial positive impact on the passage of environmental friendly laws and regulations. However, lack of public support can also act as a major barrier to transitioning to a low-carbon economy [158,159]. Thus, with the rise of right-leaning populism, public support for climate change/environmentally friendly policies may decline. This could result in fewer environment friendly laws being adopted but more importantly, implementation of existing laws may also be hampered.

Exacerbating the issue of rise of right-leaning populism leading to declining support for environmentally friendly policies is the public perception on climate change risks. Research has shown that awareness and the causes of climate change rather than the consequences are likely to increase public demands for environmental policies [160–162].

3.6. Political systems and energy transition

In this section, we review the literature on the influence of parliamentary systems on energy transition. A number of authors have argued that countries with proportional representation systems are more likely to adopt environmental policies that facilitate energy transition [163–166]. The empirical literature on this relationship is sparse; Dolšak [167] and Schaffer and Bernauer [168] argue that countries with parliamentary systems, especially those with proportional representation are more likely to adopt environmental policies.

Countries where energy regulators are considered public services and are under parliamentary authority (as in Europe), instead of being politically appointed (as in the US), are more likely to be committed to energy transitions [166,169]. Alongside, political commitment from the government in the form of budgetary measures and support for innovation [5,170,171] are key drivers to achieve sustainable energy transition. Furthermore, stakeholder perception regarding energy transition can be heterogenous across regions (even within a country). Graff et al. [172], using interviews and surveys from three US locations find that the perception on energy transition varies based on job losses and rising energy costs.

4. Existing gaps and future directions

Our review reveals four major gaps in the applied economics literature on institutions and environment. The first gap concerns the relationship between institutions and policy adoption. With respect to the choice of policy adoption indicators, only a few papers have studied the impact on policy stringency and regarding the institutional factors considered, very few papers have investigated the influence of lobbying and veto power. Understanding the drivers of policy adoption and stringency and how various economic and political institutions influence the decision-making on environmentally friendly policies need

further investigation, especially in the context of climate and renewable energy policies. New and improved data on policies, such as the Environmental Policy Stringency dataset by OECD [173] offers opportunities to investigate relationships between institutional factors and policy stringency. Questions of potential interest include whether the broader institutional setting affects decisions on the type of policy instruments and whether there is a causal relationship between indicators of institutions and policy stringency. Sub-national datasets such as the European Quality of Government Index [174] to investigate the impacts of governance within and across countries will be useful to fill this research gaps. In the specific domain of public opinion, a challenge will be to find reliable data, preferably also at the sub-national level, regarding the public opinion on individual environmental policy issues.

The second gap concerns the relationship between institutions and environmental performances. The existing literature has focused on physical environmental performance indicators, whereas only a few recent papers (see Sections 3.3, 3.4, and 3.6) explore how institutional quality affects green investments and clean technology costs. Future research should explore the relationship between institutions and variables related to green investments and the green economy. Possible indicators for this purpose include R&D investments and electricity generation from renewable sources such as hydropower, geothermal, solar, tides, wind, biomass, and biofuels or installed capacity of these sources. Future endeavors could also examine the influence of institution on technological change in relation to energy efficiency improvements or decarbonization patterns. A large body of literature analyze innovation in energy and climate-friendly technologies and their diffusion across borders (see [175] for a review), including developing countries [176,177] but only a few of these have examined the role of institutional factors. The broader literature on institution and the environment surveyed in this review suggests that other institutional factors such as corruption, transparency of governments, quality of bureaucratic quality and speed are also likely to influence the ability to adopt and implement environmental policies, the type of policies chosen, as well as the effectiveness of the policy implemented. Governance can be considered a key factor, as weak governance creates frictions and leads to increased risks and associated costs in R&D and technological investments. In the case of governance, various institutional indicators are available besides WGI, such as the Institutional Quality Dataset [12] and the Government Transparency Index [178]. In the case of investment and innovation, our review shows that they are critical drivers of energy transition and political commitment from the government in the form of budgetary measures and support for innovation are necessary alongside to achieve sustainable energy transition.

The third gap includes the impact of public opinion on types of environmental policies being adopted and the specific mechanisms at play that connects public opinion to climate laws and regulations. It is also important to investigate the reasons for changing public opinion, considering for example the perception of climate risks and impacts, on climate change and if public opinion results in specific types of environmental laws being passed. The challenge in this case is to find reliable measures of national and sub-national data on the opinion on individual policy issues, in this context big data from social network can be considered.

The fourth gap is the need to better investigate the interplay between economic, political, institutional, and socio-cultural changes, and future research should attempt to incorporate this issue accordingly.

5. Conclusion

This review surveys the existing literature on institutions, governance, populism, public opinion, and the environment by comprehending the major findings of the empirical contributions on institutions and environmental outcomes, environmental policy adoption, green investments, and energy innovation. It suggests that it is critical to expand the existing empirical literature on institutions and the environment to energy and climate change related issues, which could contribute to the broader field of energy transition and sustainable development.

Our review identifies the following major findings. First, democratic countries and open societies are more likely to provide public goods such as environmental protection, and civil and political rights are influential in ensuring environmental quality, especially compared to authoritarian regimes. Countries that are more democratic (especially those with mature and experience with democracy) are also generally associated with greater participation in international environmental agreements and with better environmental performance. Second, good governance and democracy encourages the adoption of environmental policies and generally leads to better environmental outcomes. Third, the rise of right-leaning populism could result in a decline of public support for climate change policies.

Regarding the two first findings, the analysis reveals that the literature on environmental performance is more extensive than the one focusing on environmental policy. Although there is mixed evidence on the impact of institutional quality on performance and policy adoption, the majority of these studies find a positive relationship between different indicators of institutional quality, performance, and policy adoption. Our review also shows that results are often sensitive to the indicator of institutional quality being used and divergent results can often be explained by differences in methodologies and data. For example, the use of cross-sectional regressions has led to results that more prone to omitted variable bias and endogeneity. Regarding the data, the gap in availability of environmental data between the developed and the developing countries often results in a selection bias.

Regarding the third finding, the empirical literature on the impact of populism and public opinion on environmental policy is mostly focused on the adoption and passing of environmental protection laws and regulations [135–137]. Furthermore, a significant part of this literature is focused on the US [135,138,136]. With the rise of right-leaning populism in Europe, it is critical that these issues are investigated for European countries as well.

We highlight several unexploited opportunities for future empirical work, which have emerged thanks to the growing availability of datasets on environmental policy and performance indicators. Going forward, research could explore indicators more directly related to low-carbon transformations, such as carbon and energy intensity and renewable energy mix, and their shares. The literature on the relationship between institutions and policy also shows a gap and future research could explore the drivers of climate policy adoption, including the role of public opinion. Finally, there is scope of improving the estimates by using robust empirical techniques.

Broadening the empirical evidence on the relationship between institutions, environmental outcomes, and policies could also help improve the representation of institutional factors in the quantitative system models used to develop long-term, sustainability transition scenarios. The new scenario framework integrating future climate and society [179] acknowledges the importance of policy and institutions as one of the dimensions of the Shared Socioeconomic Pathways. The economic approach to institutions and the environment reviewed in this paper can offer empirical guidance to these models (e.g. [111]).

Certainly more effort is needed along the lines of Turnheim et al. [13] to explore ways to connect richer approaches such as complex adaptive systems and socio-technical transition studies, with the positivist worldview of applied econometric methods, which are ex-post evaluations of existing policies, and of future-oriented studies, which are ex-ante assessments of future possible scenarios.

Appendix A

Table A1
Classification of Institutional Proxies.
Source: Compiled by the Authors.

Institutional variables	Source	Type
Voice and Accountability Reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.	World Governance Indicators (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	Governance
Government Effectiveness Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	World Governance Indicators (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	Governance
Regulatory Quality Reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.	World Governance Indicators (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	Governance
Ease of Doing Business Index (1 = most business-friendly regulations). Ranking of economies from 1 to 189, higher rankings (a low numerical value) indicate better, usually simpler, regulations for businesses and stronger protections of property rights.	World Development Indicators (World Bank) http://data.worldbank.org/indicator/IC.BUS.EASE.XQ	GOVERNANCE
Total Tax Rate (% of commercial profits) Amount of taxes and mandatory contributions payable by businesses after accounting for allowable deductions and exemptions as a share of commercial profits	World Development Indicators (World Bank) http://data.worldbank.org/indicator/IC.TAX.TOTL.CP.ZS	Governance
Time to resolve insolvency (years) Time to resolve insolvency is the number of years from the filing for insolvency in court until the resolution of distressed assets.	World Development Indicators (World Bank) http://data.worldbank.org/indicator/IC.ISV.DURS	GOVERNANCE
Rule of Law Reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular, the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.	World Governance Indicators (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	Governance
Strength of Intellectual Property Rights Data on the strength of the legal environment for patenting in five year-time steps from 1960 to 2005. The index contains the impacts of five categories: the coverage of research fields in which inventions can be patented, the membership in international agreements, criteria regarding the loss of patent protection, the enforcement rules, and the duration of patent protection.	Ginarte and Park [198], Park [199]	Legal
Informal payments to public officials (% of firms) Informal payments to public officials are the percentage of firms expected to make informal payments to public officials to "get things done" with regard to customs, taxes, licenses, regulations, services, and the like.	World Development Indicators (WORLD BANK) http://data.worldbank.org/indicator/IC.FRM.CORR.ZS	Political
Control of Corruption Reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	World Governance Indicators (WB WGI) http://info.worldbank.org/governance/wgi/index.aspx#home	Political
Corruption Perceptions Index (CPI) The CPI scores and ranks countries/territories based on how corrupt a country's public sector is perceived to be. It is a composite index, a combination of surveys and assessments of corruption, collected by a variety of reputable institutions.	Transparency International http://www.transparency.org/cpi2014	Political
Bribe Payers Index (BPI) Measuring the supply side of corruption in international business transaction, the Bribe Payers Index is a ranking of leading exporting countries according to the perceived likelihood of their firms to bribe abroad.	Transparency International http://www.transparency.org/bpi2011	Political
Institutionalized Democracy (eleven-point scale; 0–10) Measured by competitiveness of political participation, competitiveness of executive recruitment, openness of executive recruitment and constraints on the chief executive.	Polity IV http://www.systemicpeace.org/inscr/p4v2014.xls	Political
Institutionalized Autocracy (eleven-point scale; 0–10) Lack of political competitivenes, lack of competitiveness of executive recruitment, regulation of political participation, lack of openness of executive recruitment and the lack of constraints on the chief executive	Polity IV http://www.systemicpeace.org/inscr/p4v2014.xls	Political
POLITY Computed by subtracting the autocracy score from the democracy score; the resulting unified polity scale ranges from +10 (strongly democratic) to −10 (strongly autocratic)	Polity IV http://www.systemicpeace.org/inscr/p4v2014.xls	Political
POLITY2 Revised Combined Polity Score: This variable is a modified version of the POLITY variable added in order to facilitate the use of the POLITY regime measure in time-series analyses. It modifies the combined annual POLITY score by applying a simple treatment to convert instances of standardized authority scores to conventional polity scores	Polity IV http://www.systemicpeace.org/inscr/p4v2014.xls	Political
Electoral Democracy An electoral democracy designation requires a score of 7 or higher in the Electoral Process subcategory and an overall political rights score of 20 or higher.	Freedom House https://freedomhouse.org/report/freedom-world-aggregate-and-subcategory-scores	Political
Civil Freedom Civil liberties, including freedoms of expression, assembly, association, education, and religion. They have an established and generally fair legal system that ensures the rule of law (including an independent judiciary), allow free economic activity, and tend to strive for equality of opportunity for everyone, including women and minority groups.	Freedom House https://freedomhouse.org/report/freedom-world-aggregate-and-subcategory-scores	Political
Political Freedom Range of political rights, including free and fair elections. Candidates who are elected actually rule, political parties are competitive, the opposition plays an important role and enjoys real power, and the interests of minority groups are well represented in politics and government.	Freedom House https://freedomhouse.org/report/freedom-world-aggregate-and-subcategory-scores	Political

Table A2
Literature Survey: Institutions and Environmental Performance.
Source: Compiled by the Authors. This table summarizes 39 studies on institutions, governance, and environmental performance. Studies dealing with investments and innovation not explicitly related to the energy and environmental domains are not included in this table.

Paper	Dependent Variable(s)	Explanatory Variables	Methodology	Result
Congleton [35]. Political Institutions and Pollution Control.	Methane and CFC	Democracy [194]	2SLS and Cross-section Logit 118 countries	Democratic regimes produce more methane in total but significantly less per unit of national output.
Murdoch et al. [59]. A Tale of Two Collectives: Sulfur versus Nitrogen Oxides Emission Reduction in Europe	Reduction sulfur and nitrogen oxides	Indices of civil liberties and political freedom [195–197]	OLS 25 European countries; 1985, 1987, 1990, and 1992	Reduces sulfur emissions but not nitrogen oxides
Midlarsky [32]. Democracy and the environment: an empirical assessment.	Deforestation, carbon dioxide emission, soil erosion by water, and protected land area	Democracy	OLS Panel regression	No evidence of democracies improving soil erosion by chemicals, and freshwater availability, and even negative effects of democracies over CO2, deforestation, and soil erosion by water. The study only finds a positive effect of democracy on protected land.
Torras and Boyce [42]. Income, inequality, and pollution: a reassessment of the environmental Kuznets Curve	Sulfur dioxide, smoke, heavy particles, dissolved oxygen, fecal coliform, safe water, sanitation	Political rights and civil liberties	GLS 18–52 cities in 19–58 countries 1977–1991	Civil liberties improve environmental quality, particularly in low-income countries.
Deacon [36]. The Political Economy of Environment-Development Relationships: A Preliminary Framework.	Lead content	Types of Democracy (Cross-National Time-Series Data Archive and Polity III)	Panel OLS 1972–1992 48 countries	Lead content declines with democratic regimes compared to dictatorships.
Barret and Graddy [31]. Freedom, growth, and the environment.	Air pollutants, water pollutants, fecal and total coliforms	Civil and Political Freedom – Freedom House	FE and RE OLS 5–31 countries	An increase in civil and political liberties generally improves environmental quality.
Bhattarai and Hammig [58]. Institutions and the Environmental Kuznets curve for deforestation: A cross-country analysis for Latin America, Africa and Asia.	Deforestation	Sum of political rights and civil liberty (Freedom House)	FGLS 66 countries from Latin America, Africa, and Asia 1972–1991	Political rights and civil liberty reduces annual deforestation rate of forest and woodlands.
Ehrhardt-Martinez et al. [48]. Deforestation and the Environmental Kuznets Curve: Cross-National Investigation of Intervening Mechanisms	Annual rate of deforestation	Scope of governmental actions and Democracy (Polity II)	OLS with White correction LDCs 1980–1995	Weak democracies are unable to reduce deforestation.
Neumayer [45]. Do democracies exhibit stronger international environmental commitment? A cross-country analysis.	Percentage of their land area under protections status	Combined index of political rights and civil (Freedom House,), combined index of democracy and autocracy (Polity IV), Vanhanen's index of democracy, and Voice and accountability (WB)	Cross-section OLS 206 countries	Democracies and countries with higher Freedom Index put greater percentage of their land area under protections status.
Carlsson and Lundstrom [49]. The Effects of Economic and Political Freedom on CO_2 Emissions.	CO_2 emissions	Political and civil freedom (Freedom House)	Box-Cox regression 75 countries 1975–1995	Political freedom has no effect on reducing levels of emission of CO_2.
Deacon [37]. Dictatorship, Democracy, and the Provision of Public Goods.	Lead content of gasoline	Cross-National Time Series Data Archive [192] and Polity IV	FE OLS 130 countries 1980-1996	Lead concentrations are lower under democracy than autocracy.
Meyer et al. [3]. Institutional, social and economic roots of deforestation: a cross-country comparison.	Rate of deforestation	Control of corruption	Cross-section OLS 99–115 countries	Improved control of corruption reduces rate of deforestation.
Meyer et al. [3]. Institutional, Social and Economic Roots of Deforestation: Further Evidence of an Environmental Kuznets Relation?	Deforestation	Property Rights (Freedom House) and Control of Corruption Index (WB)	Cross-section OLS 117 countries	Countries with less corruption are less likely to liquidate forest assets.
	Lead content of gasoline			

(*continued on next page*)

Table A2 (*continued*)

Paper	Dependent Variable(s)	Explanatory Variables	Methodology	Result
Fredriksson et al. [40]. Environmentalism, democracy and pollution control.		Number of environmental lobby groups, democratic participation, and political competition	Cross-section OLS, Tobit, and 2SLS 104 countries Around the year 1996	Increase in the number of environmental lobby groups, democratic competition and participation reduces lead content in gasoline.
Neumayer [75]. Are left-wing party strength and corporatism good for the environment? Evidence from panel analysis of air pollution in OECD countries.	Sulfur dioxide; nitrogen dioxide; carbon monoxide; carbon dioxide	Left-wing party strength (the share of green/left-libertarian party seats as a percentage of all seats, the share of traditional left-wing party seats, and the share of cabinet portfolios of left-wing parties - Comparative Parties Data Set of Swank, 2002)	FE/RE regression 21 OECD countries, 1980, 1990 and 1999	Green or left-libertarian parliamentary strength is associated with lower levels for all five air pollutants. Traditional left-wing party strength is possibly also associated with lower pollution levels, but the evidence is less consistent and robust.
Welsch [66]. Corruption, growth, and the environment: a cross-country analysis.	Urban SO_2 concentration, Urban NO_2 concentration, urban total suspended particulate concentration, dissolved oxygen demand, phosphorus concentration, suspended solids, SO_2, NO_2, volatile organic compound emissions, fertilizer consumption, pesticide use, industrial organic pollutants	Corruption (ESI)	Cross-section OLS and SUR 122 countries Most recent year available; 1990–1996	Corruption generally increases pollution and the effect is particularly strong in low-income countries.
Binder and Neumayer [44]. Environmental pressure group strength and air pollution: An empirical analysis.	Sulfur dioxide, smoke, and heavy particles	ENGOs' strength and Democracy (Policy IV)	Panel OLS, RE, and IV regression 17–35 countries, 1977–1988	ENGO strength is effective in reducing air pollution levels in the form of SO2, smoke and heavy particulates.
Esty and Porter [43]. National Environmental Performance: An Empirical Analysis of Policy Results and Determinants.	Urban particulate levels, and sulfur dioxide	Civil and political Liberties – Environmental Sustainability Index (ESI)	OLS 40–70 countries	Civil and political liberties help reduce urban particulates and SO_2.
Jorgenson [50]. "Global warming and the neglected greenhouse gas: a cross-national study of the social causes of methane emissions intensity	CH_4 intensity	Index of democratization	Cross-section OLS with listwise deletion 39–68 countries for 1995	Democratization has no effect on methane intensity
Li and Reuveny [41]. Democracy and Environmental Degradation.	Carbon dioxide, nitrogen oxides, organic pollution in water, deforestation, and land degradation	Democracy and autocracy (Polity IV),	Panel and cross-section OLS 105–143 countries 1961–1997	Democracy improves environmental quality regarding all the dependent variables.
Cole [67]. Corruption, income and the environment: An empirical Analysis.	Sulfur dioxide and carbon dioxide	Corruption (ICRG)	Instrumental Variable RE 94 countries 1987–2000	Corruption is estimated to have a positive direct impact on per capita emissions. Indirect effects are found to be negative and larger in absolute value than direct effects for the majority of the sample income range.
Culas [57]. Deforestation and the environmental Kuznets curve: An institutional perspective.	Deforestation of forests and woodlands	Enforceability of contract	FE and RE OLS 14 countries from Latin America, Africa and Asia 1972–1994	Better enforceability of Contracts reduce deforestation.
Fredriksson and Wollscheid [189]. Democratic institutions versus autocratic regimes: The case of environmental policy	Greenhouse gases – reductions in carbon dioxide per unit of GDP, and carbon dioxide emitted per capita	Democracies – parliamentary, presidential-congressional, proportional, and/or majoritarian systems compared to dictatorships.	Cross-section Propensity score matching 163 countries from late 1990's.	Parliamentary democracies achieve greater reductions in greenhouse gases. While presidential democracies act similar to autocracies.
Shandra [47]. Economic dependency, repression, and deforestation: A quantitative, cross-national analysis.	Deforestation	Average of political rights and civil liberties (Freedom House)	Cross-section OLS 67 countries around 1990	Deforestation increases in nations with higher levels of repression.
Wright [70]. Poverty and corruption compromise tropical forest reserves.	Number of fires	Corruption (TI)	Non-parametric sign test and OLS 37 countries 2002–2004	Reserves are least effective at reducing fire frequency in many poorer countries and in countries beset by corruption.
Political Regimes, Democratic Institutions and Environmental Sustainability: A Cross-national analysis.	Carbon monoxide, biochemical oxygen demand, SO_2, NO_2, CO_2, CH_4, protected areas, and forest land	Democracy (Freedom House and Polity IV)	Cross-section OLS 169 countries,	No evidence that long-established democratic countries perform better.

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Table A2 (*continued*)

Paper	Dependent Variable(s)	Explanatory Variables	Methodology	Result
Ward [46]. Liberal Democracy and Sustainability	Carbon footprint	Polity score, political system	Cross-sectional analysis 60–128 countries around the year 2000	Stable core autocracies perform worse on strong sustainability than stable core democracies. Liberal democracy too generally promotes weak sustainability
Bernauer and Koubi [39]. Political Determinants of Environmental Quality.	Sulfur dioxide	Democracy [38], Presidential vs. Parliamentary [38], Civil liberties (Freedom House)	RE GLS 107 cities in 42 countries from 1971–1996	Democracy reduces pollution, presidential democracies provide a cleaner environment than parliamentary democracies, and civil liberties improve the environment.
Koyuncu and Yilmaz [71]. The Impact of Corruption on Deforestation: a Cross-Country Evidence.	Rate of deforestation	Corruption (TI, BI, and ICRG)	WLS 100 countries 1980–90, 1990–95, 1990–2000	Corruption increases rate of deforestation.
Buitzenzorgy and Mol [53]. Does Democracy Lead to a Better Environment? Deforestation and the Democratic Transition Peak	Rate of deforestation	Democracy (Polity IV)	OLS and cluster analysis 177 countries 1990–2000	EKC relationship between democracy and deforestation rate and deforestation rates are lower under autocracy and mature democracy.
Ivanova [89]. Corruption and air pollution in Europe.	Sulfur emissions	Corruption and law and order (ICRG)	ML with FE and SUR 39 European countries 1999–2003	Decline in corruption and improvements in law and order reduces sulfur emissions. Actual emission levels in countries with more effective regulations are likely to be lower.
Gennaioli and Tavoni [106]. Clean or "Dirty" Energy: Evidence on a Renewable Energy Resource Curse	Number of wind plants and total capacity installed	Number of charges made by police for criminal association activity and total criminal activity -	Panel OLS, difference-in-differences 34 South-Italian provinces 1990–2007	Expansion of the wind energy sector has been driven by quality of political institutions, through their effect on criminal association.
Rule of Law and the Environmental Kuznets Curve: Evidence for Carbon Emissions.	EKC and carbon emissions	Rule of law Kaufman et al. [10]	2SLS 28 countries 1996–2008	Negative relationship between pollution and rule of law, when rule of law is strong, the turning point of the EKC occurs at a lower level of income per capita, thus, decreasing emissions
Castiglione et al. [55]. Institutional enforcement, environmental quality and economic development.	Income and pollution (carbon dioxide)	Rule of law Kaufman et al. [10]	Panel VAR 33 high-income countries 1996–2008	Higher income implies stronger rule of law and vice-versa. Rule of law has a negative relationship with pollution.
Koubi et al. [190]. Climate variability, economic growth, and civil conflict.	1st stage: Economic growth 2nd stage: Onset of civil conflict	Polity (Polity IV)	2SLS Global dataset 1980–2004	No evidence that climate variability affects economic growth. Weak evidence that non-democratic countries are more likely to experience civil conflict when economic conditions deteriorate.
Masini and Menichetti [113]. Investment Decisions in the Renewable Energy Sector: An Analysis of Non-Financial Drivers.	Renewable energy share in the investment portfolio	Institutional pressure from industry peers, consultants, and published technical information	Cross-section OLS and logistic regression. Survey data from 93 investors in Europe	Institutional pressure of both peers and outside consultants has a strong negative impact on portfolio – forces them to concentrate investments on a few specific technologies.
Iyer et al. [111]. Improved representation of investment decisions in assessments of CO_2 mitigation.	Investment risks across technologies and regions in the electricity generation sector	Institutional quality	IAM – Global Change Assessment Model	Investment in low-carbon technologies is lower in regions with inferior institutions.
Verdolini and Vona [112]. Drivers of investments in cleaner energy.	Change in installed capacity of renewable and fossil efficient as a fraction total capacity	Policy instruments supporting either renewable or fossil efficient technologies –WEO Policy Database	FE difference-in-differences 27 OECD countries over the years 1990–2007	Environmental policy has a positive effect on investment in renewable energy technologies but fossil efficient technologies seem less affected.
Dasgupta et al. [6]. The political economy of energy innovation.	Innovation measured by power and energy R&D intensity and power and environmental patent intensity	Institutional quality (WGI), governments' political orientation, and lobbying	FE OLS 20 countries 1995–2010	Stringent environmental policies and better governance provide incentives for energy innovation; left-leaning governments and market size attract energy R&D but not patents.
Joshi and Beck [54]. Democracy and carbon dioxide emissions: Assessing the interactions of political and economic freedom and the EKC.	CO_2 emission rate	Political freedom (Freedom House); Economic freedom (Heritage Foundation)	GMM 22 OECD and 87 non-OECD countries 1995–2010	Political freedom increases emissions in OECD countries but has no effect in non-OECD countries. Economic freedom increases emissions.

Table A3
Literature Survey: Institutions, Governance, and Environmental Policy (Adoption and Implementation).
Source: Compiled by the Authors. This table summarizes 16 studies on institutions, governance, and environmental policy.

Paper	Dependent Variable (s)	Explanatory Variables	Methodology	Result
Congleton [35]. Political Institutions and Pollution Control.	Signature of Vienna and Montreal Protocol on CFC	Democracy [194]	Cross-section Logit 118 countries	Authoritarian regimes enact less stringent environmental standards than democratic regimes. Liberal democracies are more willing to regulate environmental effluents and international agreements on environmental matters attract more signatories as the number of democratic regimes increases.
Neumayer [45]. Do democracies exhibit stronger international environmental commitment? A cross-country analysis.	Signing and ratification of multilateral environmental agreements; membership in environmental intergovernmental organizations; reporting requirements for the Convention on International Trade in Endangered Species of Fauna and Flora; percentage of a country's land area under protection; existence of a National Council on Sustainable Development; and availability of environmental information	Democracy (Freedom House, Polity IV, Vanhanen's Index, and Voice and Accountability – WB)	Cross-section Probit and OLS 100–175 countries, around the year 2000	Democracies sign and ratify more multilateral environmental agreements, participate in more environmental intergovernmental organizations, comply better with reporting requirements under the Convention on International Trade in Endangered Species of Fauna and Flora.
Fredriksson and Svensson [87]. Political instability, corruption and policy formation: the case of environmental policy.	Index of stringency of environmental regulations on agricultural sector.	Corruption (Political Risk Services and ICRG) and Democracy (Freedom House)	Cross-section OLS 63 countries for 1990	More corrupt countries have less stringent environmental regulations while democratic countries also have less stringent regulations.
Murdoch et al. [77]. The participation decision versus the level of participation in an environmental treaty: a spatial probit analysis	Helsinki protocol ratification and sulfur emissions (1990 levels minus 1980 levels)	Democracy proxy – civil and political freedom Gastil [195]	Two-stage game and spatial Probit 25 European countries	Democracy reduces probability of protocol ratification.
Damania et al. [76]. The Persistence of Corruption and Regulatory Compliance Failures: Theory and Evidence.	Compliance with international environmental agreements.	Judicial efficiency (Kauffman), political stability (Kauffman), civic freedom (Frasier Institute), and corruption (TI)	Cross-section OLS and 2SLS	Corruption reduces the level of compliance of environmental regulations while civic freedom and judicial efficiency increases compliance.
Fredriksson et al. [83]. Corruption and Energy Efficiency in OECD Countries: Theory and Evidence.	Sector specific energy policy stringency	Corruption (TI), worker influence, and lobbying	Panel OLS 12 OECD countries (11 sectors) 1982–1996	Corruption increases energy waste by reducing stringency of energy regulations. Worker lobby is relatively influential in those sectors in which the capital owners have relatively minor impact, and vice versa.
Fredriksson and Millimet [84]. Electoral rules and environmental policy.	Environmental Sustainability Index, Environmental Governance Index, Environmental Efficiency Index, International Environmental Agreements Participation Index, and Greenhouse Gas Emissions Index	Rules governing the assignment of legislative seats	Cross-section OLS and 2SLS 86 countries	Governments set stricter environmental policies under proportional, as opposed to majoritarian systems.
Roberts et al. [82]. Who Ratifies Environmental Treaties and Why? Institutionalism, Structuralism and Participation by 192 Nations in 22 Treaties.	Environmental Treaty Participation Index – participation on 22 international environmental treaties	Index of Voice and Accountability, Government Effectiveness Index (Kauffman et al., 2003), and Number of NGOs	Cross-section OLS, 192 countries, 1999	Positive relationship with national propensity to sign environmental treaties.
Fredriksson et al. [40]. Environmentalism, democracy, and pollution control.	Regulation of lead content in gasoline	Environmental lobby; Democratic participation; and Democratic competition	Cross-section OLS, 2SLS, Tobit 104 countries, 1993, 1996, and 2000	Greater political competition and number of environmental groups raises the stringency of environmental policies. However, democratic participation affects environmental policy stringency only in countries with sufficiently high degree of political competition.
Fredriksson and Millimet [188]. Legislative Organization and Pollution Taxation.	Environmental protection and pollution taxation	Veto, bicameralism, political instability, and corruption Kaufmann et al. [200] index	Three-stage game Cross-section 86 countries	Bicameralism has a positive effect on gasoline taxes that is magnified as political stability increases and veto players are less corruptible. Similar interaction effect of bicameralism and the degree of corruptibility for various measures of environmental policy stringency.
Fredriksson and Ujhely [78]. Political institutions, interest groups, and the Ratification of international environmental agreements.	Probability of Kyoto protocol ratification	Government units, environmental lobby, democracy (Freedom House),	Logit and stratified hazard model 170 countries 1998–2002	Greater environmental lobby strength raises the probability of ratification but greater number of government unites reduce the impact of agreements.

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Table A3 (*continued*)

Paper	Dependent Variable (s)	Explanatory Variables	Methodology	Result
Fredriksson et al. [73]. Kyoto Protocol cooperation: Does government corruption facilitate environmental lobbying?	Kyoto Protocol ratification	Democracy (Freedom House, corruption (TI), integrity (WB, TI, ICRG), and environmental lobbying	Cox proportional hazard model 170 countries 1998–2002	Democratic countries ratify earlier, environmental lobbying raises the ratification probability, while increased environmental lobby group activity raises the probability of Kyoto Protocol ratification and the effect raises with the degree of corruption.
Bättig and Bernauer [79]. National Institutions and Global Public Goods: Are Democracies More Cooperative in Climate Change Policy?	Policy Index: commitment to mitigation process Policy outcomes: in terms of emission levels and trends	Democracy	Panel regression 185 countries 1990–2004	Effect of democracy on commitment to global public goods provision is positive while effect of democracy on policy outcomes are ambiguous.
Cole and Fredriksson [187]. Institutionalized pollution havens.	1st stage: FDI stock 2nd stage: Environmental policy	Government checks and balances; political constraints within the legislature; and government honesty (ICRG)	FE 2SLS 33 countries 1982–1992	FDI raises environmental policy stringency where number of legislative units is high.
Pellegrini and Gerlagh [88]. Corruption, Democracy, and Environmental Policy: An Empirical Contribution to the Debate	Environmental Protection Stringency [193] and Environmental Regulatory Regime Index [43]	Corruption (TI), Democracy (Polity IV), and Index of democracy [203]	Cross-section FE OLS 51-62 countries	Effect on environmental policy stringency is negative for corruption but no evidence significant effect of democracy.
Fredriksson and Neumayer [80]. Democracy and Climate Change Policies: Is History Important?	Stringency of climate change policies (Climate Laws, Institutions and Measures Index) and Global Environmental Cooperation Index	Democratic capital and stock (*Polity2* Polity IV)	Cross-section FE OLS and IV regression 87 countries	Historical experience with democracy rather than current level of democracy is more important for stringent environmental policies.
Fankhauser et al. [81]. Domestic dynamics and international influence: What explains the passage of climate change legislation?	Number of climate laws passed and flagship legislation	Polity2 (Polity IV), party-political orientation of the government, and international influences	Negative binomial and FE Logit 63 countries 1990–2012	No significant impact of political orientation. Propensity to legislate is heavily influenced by the passage of similar laws in other countries.
Fredriksson and Neumayer [90]. Corruption and Climate Change Policies: Do the Bad Old Days Matter?	Stringency of climate change policies (Climate Laws, Institutions and Measures Index)	Current corruption control and capital of corruption control (ICRG & WB)	Cross-section FE OLS 131 countries	Accumulated history of low corruption increases cooperation on environmental policies.

Table A4
Literature Survey: Public Opinion and Environmental Policy (Adoption).

Paper	Dependent Variable (s)	Explanatory Variables	Methodology	Result
The policy impact of the U.S. environmental movement	Number of environmental laws passed in the US	Environmental movement protest activity and public opinion on federal environmental Legislation (environmental attitudes index from the New York Times Annual Index)	Time-series regression for the US. 1960–1998	Increase in public support along with protest/advocacy for environmental protection has a positive impact on the passage of environmental laws. Public opinion on policy may be amplified by protests.
Shum [142] Can attitudes predict outcomes? Public opinion, democratic institutions and environmental policy	Environmental performance index score	Public opinion and voter information. World Values Survey [201,202]	Panel regression using country-level data 1995–2005	Information-based model incorporating public opinion effects has significant effects on environmental policy outcomes.
Johnstone et al. [140] Movement organizations, synergistic tactics and environmental public policy	Passage of pro-environmental laws (agenda setting and final passage in the US Congress)	Environmental movement collective action events (The Dynamics of Social Protest Project)	Poisson and negative binomial regressions for the US 1961–1990	Public opinion and protest movements on environmental issues have a greater influence on Congressional-agenda setting than on actual passage of environmental laws.
Anderson [136] Complex constituencies: intense environmentalists and representation	Environment related voting behavior of members of the US Congress (League of Conservation Voters' Environmental Score)	Environmental group membership as a proportion of district population.	OLS regressions for US Congress 1997–1998	Constituents with intense preferences on particular issues seem able to influence the voting behavior of members of Congress. Members of Congress vote more pro-environmental when there are more members of environmental groups in their district.
Vandeweerdt et al. [141] Climate voting in the US Congress: the power of public concern	Votes cast on four legislative proposals to limit greenhouse gas emissions	Public opinion on climate change from Cooperative Congressional Election Study surveys	Multilevel regression, post-stratification, and logistic regression with fixed and random-effects 2006–2007 and 2010–2012	Strong relationship between public opinion and congressional votes on climate laws, even after controlling for confounding variables such as presence of interest groups and campaign contributions.
Anderson et al. [137] Public opinion and environmental policy output: a cross-national analysis of energy policies in Europe	Number of renewable energy policies introduced by European counties	Public opinion on climate change (EU Eurobarometer survey)	OLS and negative-binomial with country fixed-effects 1974–2015	Shifts in public opinion in the direction of pro-environmentalism significantly increase the adoption of renewable energy policies in Europe.

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